



Richmond/Southeast
PADRECC
Parkinson's Disease Research Education and Clinical Center
Hunter Holmes McGuire Veterans Affairs Medical Center
1201 Broad Rock Boulevard, Room 2C-114 (652/127)
Richmond, VA 23249

Deep Brain Stimulation (DBS) Fact Sheet

When is it time to consider DBS surgery?

When the regimen of existing medications and the various rehabilitation strategies become less effective in managing symptoms, surgical intervention can be considered.

Such an intervention is deep brain stimulation (DBS). This is a surgical intervention used to treat movement disorders such as essential tremor (ET), Parkinson's disease (PD) and dystonia. It received approval from the Food and Drug Administration (FDA) to treat essential tremor and tremor in Parkinson's disease in July 1997 and for advanced motor symptoms of Parkinson's disease in January 2002. It is currently approved for the treatment of dystonia through a "humanitarian device exemption."

The *subthalamic nucleus* (STN) and the *globus pallidus* (GPi) are two locations in the brain that are targeted in the DBS procedure for the treatment of Parkinson's disease. DBS administers a well-controlled electrical current into the target area(s). This electrical current functions as an "off switch" by disrupting abnormal brain signals responsible for the abnormal physical movement. This disruption helps restore more normal activity in the brain thus enabling more controlled movement. DBS does not involve destruction of brain tissue and its effects are reversible and adjustable. It is now preferred over the *thalamotomy* or *pallidotomy*, two surgical techniques that involve the actual destruction of the brain cells that are "misfiring." The GPi is the target area for treatment of certain forms of dystonia such as torticollis and primary dystonia as well as for treatment of Tourette's syndrome. The thalamus (VIM) is the target area for treatment of tremor disorders such as essential tremor. The anterior nucleus of the thalamus (ANT) is targeted for intractable epilepsy. The nucleus accumbens is targeted for the treatment of obsessive-compulsive disorder. Research is also underway examining the effectiveness of DBS for treatment of disorders including depression, cluster headaches, and dementia.

Who is a Good Candidate for DBS Surgery?

Good candidates are patients who:

- (For people with PD) initially had a good response to medications but later developed side effects that limit their effectiveness. Such side effects include: dyskinesias (extra movements), motor fluctuations including "wearing off" periods (medication wears off before the next dose is due), neuro-psychiatric complications such as hallucinations and other side effects such as nausea and hypotension.
- have significant tremors even if the tremor has never been adequately managed by the PD medications
- have essential tremor (ET) which is interfering with one's functioning and is not responsive to medications.
- have dystonia such as cervical dystonia or torticollis, primary dystonia and related conditions. Dystonia refers to a broad category of conditions and is evaluated on a case-by-case basis.

Who might NOT BE considered for DBS surgery?

Poor candidates for DBS surgery are patients who:

- are too unhealthy to undergo surgery
- have significant dementia. These individuals tend to recover more slowly, or not at all from surgery, and their dementia may even worsen. In addition, improved mobility from surgery, in the face of worsening dementia, often creates many new challenges.
- are diagnosed with Parkinson's plus or atypical parkinsonism syndromes such as multiple system atrophy and progressive supranuclear palsy and/or who have never responded to PD medications

Conditions which may alter the procedure or require additional discussion

- cardiac pacemakers and defibrillators
- regular MRI imaging of the body
- anti-coagulant therapy such as Coumadin or Aggrenox

For appointments and information please call
(804) 675-5931 ♦ toll-free (800) 784-8381 ext. 5931 ♦ Fax: (804) 675-5939
www.parkinsons.va.gov/Richmond

What are the Benefits and Risks of DBS?

Symptoms that **significantly improve** with DBS surgery for PD:

- festinating gait
- freezing episodes
- motor fluctuations
- tremor – arms, legs, voice and head
- rigidity
- dystonia
- slow movements or bradykinesia

Symptoms that **may improve** with DBS surgery for PD:

- masked face
- pain related to tremor, stiffness, or dystonia

Symptoms that **will not improve or may worsen during DBS surgery for PD:**

- hypophonic (soft) speech
- dementia
- mood - depression, anxiety, obsessive or compulsive

How Does DBS Effect Memory and Cognition?

Patients with normal memory function show no significant post operative decline in most routine memory tests.

Patients with dementia however do experience a decline over time which represents the natural history of dementia.

What Can Be Expected from DBS for PD?

On average, DBS surgery results in a 40-60% improvement in slowness and stiffness and up to 80% for tremor. For those with PD, many experience fluctuations between periods where their medicines are acting optimally or “on time” and when their medicines are providing little to no benefit or “off time.” We expect DBS to improve the “off” times to a pre-operative “best on” level of functioning. The “best on” periods are expected to improve only slightly however. This rule, however, does not apply to those who can’t tolerate the medicines, nor does it apply to those with dyskinesia or tremor. For patients with dystonia, we expect to see a decrease in abnormal motions and a gradual improvement in posture(s).

What are the Potential risks of DBS surgery?

- 1-3% risk of intracranial hemorrhage which can lead to loss of speech, paralysis, coma, or death.
- 5% risk of infection which usually requires removal of the DBS system.
- 2% risk that DBS will offer little or no benefit. This can be due to a wrong diagnosis such as a Parkinson's Plus condition or to suboptimal lead placement requiring revision.
- risks of anesthesia which are dependent on the patient's overall medical history.

How to get started? DBS Pre-Operative Evaluation

After initial contact is made, patients are given a packet of educational materials, clinical notes are obtained from the referring neurologist and primary care provider. If a patient has not been seen by a neurologist, an appointment with a movement disorders specialist will be scheduled to confirm that the patient is a good candidate for surgery.

Steps of the evaluation process

1. Evaluation of diagnosis, stage of disease, evaluation of the patient's general health, and discussion of surgery.
2. Off PD medication/on PD medication motor examination for those with PD. The degree of impairment that patients experience when their medicines are not working or “off” time can be assessed by performing an examination of the patient after s/he has been off all PD medications for approximately 8 hours (“off score”). This is compared to the benefit that the patient gets when their medications are working or “on score” assessed after taking the PD medications.
3. Neuropsychological testing
4. MRI and CT scans for intraoperative guidance.

If the results from these tests are within the desired range to proceed with surgery, patients will then undergo a detailed history & physical exam, and an anesthesia evaluation.

How is DBS Performed?

The surgical technique used by the Richmond team typically utilizes frameless stereotaxy, microelectrode recording (MER), and test stimulation to place the DBS lead in the best possible location within the brain. Some surgeries are performed with the patient asleep throughout the procedure while in others, the patient is awoken from sedation for a 30-60 minute period of testing.

Many patients have seen videos of surgery where a stereotactic frame is used. This is a large metal ring that is attached to the patient's head by four pins. We have replaced this framed approach with a frameless one. Pre-operative CT and MRI scans are done prior to the day of surgery. The neurosurgeon uses these merged scans to create a surgical plan in order to avoid blood vessels and to optimize lead trajectories.

Unilateral versus Bilateral Lead Placement

Unilateral placement may be appropriate for patients who have more troubling symptoms on just one side. It is also considered if a patient is frail and who may not be able to tolerate a longer surgery due to fatigue and other factors.

Day of surgery

On the day of surgery, the patient is positioned comfortably in the operating room with his/her head and neck resting on a cervical support which is attached to the table. The front of the collar is used to secure the patient while asleep but is removed once fully awake and conscious. Patients with short hair (chin length or shorter) may choose to keep their hair or have it all clipped off during surgery. Heavy sedation is used while a skin incision(s) and burr hole(s) is made. Each incision is about 2 inches long and is located on top of the head, just above the forehead. The burr hole is about the size of a dime.

For STN and GPi targets, once the microelectrode is in place, the patient is awakened. MER begins at this time. The device used to hold and advance the microelectrode is attached directly to the burr hole allowing patients to adjust their head position in an effort to get more comfortable. This is possible because all of the equipment moves as a unit with the patient. Once the MER is completed, test stimulation is performed to determine efficacy and side effects. The microelectrode is adjusted if there is little improvement or if there are troubling side effects and this is done through the same burr hole. MER may or may not occur for the VIM target. Patients who choose to have surgery under general anesthesia do not undergo this additional testing. Instead, the MRI is used by itself to help with placement of the DBS.

Once an optimal spot is located, the actual DBS lead is inserted and secured into place. This process is repeated for the other side of the brain for patients undergoing bilateral stimulator placement.

The battery and extensions are placed several days later under general anesthesia after patients have fully recovered from the intracranial surgery. However, unilateral lead placement is shorter and less tiring so that the battery and extension are generally placed on the same day as the DBS lead.

Post-Operative Care and Recovery

Patients who have a unilateral stimulator placed usually have the battery implanted during the same surgery. Most are discharged from the hospital the day after surgery.

Patients who have bilateral stimulators placed usually require a 1-2 day hospital stay after stimulator placement. Patients who are in poor health before surgery will recover more slowly and may require a prolonged stay in the hospital or rehabilitation facility.

The battery implantation procedure is performed as an outpatient surgery approximately 3-7 days following lead placement under general anesthesia. The DBS system will be turned on approximately 2 weeks after surgery during a routine clinic visit for suture removal. Testing all electrodes for efficacy and side effects or "mapping" occurs 1 month after surgery.

Patients continue on their preoperative medications unless they are causing troubling side effects. The medications are adjusted by the neurologist as necessary as the stimulation is maximized. The goal is to optimize the patient's motor functioning while eliminating those medications that cause troublesome side effects.

Additional programming visits may be necessary for the first 3 months. Once the stimulation is maximized, these visits tend to occur less frequently, typically only once or twice per year.

Post-Operative Limitations

Patients may have an MRI scan if they have MRI-compatible DBS devices and if the electrode impedance is within normal limits. The MRI staff must be specially trained and the MRI scanner determined to be safe to use with

people with DBS. Patients may not have diathermy or therapeutic ultrasound. However, diagnostic ultrasound is safe.

If patients undergo any surgery, bipolar cautery or Plasma Blade may be used. Monopolar cautery, using a Bovie, carries some restrictions. If surgery is required within 3 inches of any of the DBS components (battery, extensions, leads) a DBS surgeon should be involved in the case.

For Medtronic devices: If you or your providers have any questions regarding the use of certain equipment with Medtronic DBS devices, please direct them to the technical support center at (800) 707-0933 for Medtronic devices.

Battery Replacement

DBS batteries typically last for 3-5 years, depending on the settings. The replacement of the battery is done on an outpatient basis and is performed with local anesthetic with the option of IV sedation. The actual surgery takes about 15 minutes and the risks involve damage to or infection of the system. Rechargeable batteries last approximately 15 years but require daily charging.

What Movement Disorders Can Be Treated with DBS?

We offer DBS surgery for medically refractory movement disorders including:

- Parkinson's disease (PD)
- Essential Tremor (ET)
- Dystonia (Torticollis, Primary)
- Tourette's Syndrome

The pre-surgical work-up may vary depending on the disorder.

About the Neurosurgeons

Kathryn Holloway, M.D.

Dr. Holloway is the Neurosurgical Director at the Southeast/Richmond Parkinson's Disease and Clinical Center (PADRECC) and Chief of Neurosurgery at Hunter Holmes McGuire VAMC. She is also an attending surgeon and full professor at Virginia Commonwealth University Health System/Medical College of Virginia. She has been performing DBS since 1996. She has been a member of the Executive Committee of the American Society of Stereotactic and Functional Neurosurgery. Dr. Holloway is an innovator in the development of improved surgical techniques for DBS surgery, and is well published in the movement disorders field. She serves as an instructor for other surgeons learning DBS surgery techniques.

Paul Koch, M.D.

Dr. Koch joined the PADRECC team in 2018 and performs DBS and other surgeries here and at VCU. He is an assistant professor at VCU School of Medicine. He completed his residency training at the University of Pennsylvania, and a fellowship in Stereotactic and Functional Neurosurgery at Emory University. Dr. Koch's clinical interests include the surgical treatment of epilepsy, stereotactic therapies for movement disorders and other conditions, including deep brain stimulation and lesioning, and the treatment of pain through open and neuromodulatory therapies. He also has a strong interest in traumatic brain injury, both the acute management and the long-term cognitive sequelae, including the development of post-traumatic epilepsy.

Whom to Contact for Additional Information?

For Veterans:

Richmond Southeast PADRECC

Main office: (804) 675-5931 or DBS clinic: (804) 675-6284

For Non-Veterans

Virginia Commonwealth University Health System

Department of Neurosurgery

Movement Disorders Clinic

(804) 828-9165

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